

CIFA-WorldFish Project

Annual Report for Period January to December 2012

**“GENETIC IMPROVEMENT OF FRESHWATER PRAWN
MACROBRACHIUM ROSENBERGII (DE MAN) IN INDIA –
PHASE TWO”**



CIFA-WORLDFISH PROJECT
ON
“GENETIC IMPROVEMENT OF FRESHWATER PRAWN *MACROBRACHIUM*
***ROSENBERGII* (DE MAN) IN INDIA- PHASE TWO”**
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- 1. Project Title:** *Genetic improvement of freshwater prawn, Macrobrachium rosenbergii (de Man) in India (Phase Two).*
- 2. Participating Institutes:** C.I.F.A., Bhubaneswar and WorldFish, Malaysia
- 3. Place of operation:** C.I.F.A., Bhubaneswar
- 4. Main objectives:**
 - Production of generations two, three and four of giant freshwater prawn, *Macrobrachium rosenbergii* through selective breeding.
 - On farm testing of Generation 3 (G3).
 - Incorporation of survival rate as an additional trait in the breeding objective
 - Genotype by environmental interaction studies.
- 5. Broad technical program of activities:**
 - Upgrading and renovation of the hatchery and rearing facilities.
 - Recruitment of project staff.
 - Production of 2nd generation progeny (mating of 1st generation brood stock).
 - Larval rearing and nursing of 2nd generation of selectively bred prawns.
 - Tagging and grow-out of 2nd generation of selectively bred prawns.
 - Harvest, data collection and statistical analysis of 2nd generation.
 - Genetic evaluation and preparation of mating for the next cycle of production.
 - Meeting and group discussion.
 - Production of 3rd generation progeny (mating of 2nd generation brood stock).
 - Larval rearing and nursing of 3rd generation of selectively bred prawns.
 - Tagging and grow-out of 3rd generation of selectively bred prawns.
 - Harvest, data collection and statistical analysis of 3rd generation.
 - Genetic evaluation and preparation of mating for the production of 4th generation.
 - On-farm testing of G3 and G4.

Freshwater prawn hatchery:



6. Date of commencement: October 2010.

7. Date of completion: December 2012 (may be extended to December 2013).

8. Total budget : 92.50 lakhs (USD \$201,297.58 -Proposed)

Budget to CIFA (First Year) \$51842.56 (23.10 lakhs, received at CIFA in February 2011)
(Second Year) \$51842.56 (23.44 lakhs, received at CIFA in December 2011)
(Third Year) \$43312.00 (23.82 lakhs, received at CIFA in January 2013)

9. Targets (January to December 2012)

- Tagging of 45 full sib families of Generation 3 (G3) of selectively bred *M. rosenbergii*.
- Grow-out of tagged juveniles from 45 full sib families of G3.
- On-farm testing of G3
- Final data collection of G3 after 120 days of grow-out.
- Data entry and statistical analysis of G3 grow-out data.
- Final data collection of on-farm testing.
- Meeting and group discussion
- Genetic evaluation and preparation of mating for the production of Generation 4 (G4).
- Production of G4 progeny (mating of G3 brood stock)
- Larval rearing and nursing of G4.
- Tagging and grow-out of G4.
- On-farm testing of G4.

10. Brief account of achievements

- Individually tagged 3628 prawn juveniles from 45 full sib families of G3 with visible implant alpha numeric tag and stocked in three 400 m² ponds for grow-out. All prawns were measured individually for total length, carapace length, standard length and wet weight before tagging.
- Grow out evaluation of G3 was carried out in three 400 m² (0.04 ha) earthen ponds. The tagged prawns were stocked at 3/m² and reared for 120 to 130 days.
- At harvest all survived prawns were collected and classified by sex and male morphotype, all prawns were measured for carapace length, standard length, total length and individual weight, tag numbers in those with readable tags were also noted.
- Data entry and genetic evaluation of grow-out data was carried out, estimated breeding values of G3 individuals and ranked families and individuals for undertaking fourth round of selection and mate allocation.
- Produced 58 full sib families of G4.

- Post larvae from all the 58 full sib families were nursed up to taggable size in nylon hapas (116 hapas).
- The nursed juveniles from each of the 45 full sib families were divided into two groups and one group (140 individuals) stocked in two large nylon net hapas (5x2x1m) for grow-out. These hapas were fixed in 100 m² concrete tanks or ponds. The other group (60 individuals) was individually tagged and stocked in two 0.04 ha earthen ponds for communal grow-out. All tagged prawns were measured individually for total length, carapace length, standard length and wet weight before tagging. Grow-out is continuing.
- Four farms in Orissa were selected for on-farm testing of G3 and supplied with 9200 juveniles (2.8 g) for stocking. Prawns were stocked at 3 m⁻² and reared for 120 to 130 days. Monitored the growth of prawns at monthly intervals.
- Completed final data collection of on farm testing.

Detailed report of activities and achievements

1. Grow out evaluation of Generation 3

The grow-out of the third generation was carried out in three 400 m² (0.04 ha) earthen ponds. A total of 3628 juveniles (1.73±0.65g) from 45 full sib families were individually identified with VIA tags and stocked in well prepared grow-out ponds. The tagged prawns were stocked at 3 m⁻² and reared for 120 to 130 days. Prawns were fed twice daily with commercial pellet feed at 10% of the biomass per day in the first month. The feeding rate was modified every month based on the body weight obtained during sampling. Water quality was maintained by frequent addition of water. Dissolved oxygen, pH and ammonia levels were measured once every week using standard procedures. Ponds were provided with continuous aeration from an air blower.

2. Harvest and data collection of Generation 3

After completion of the grow-out period, ponds were completely emptied and all surviving prawns were collected and classified by sex and morphotype. All prawns were measured for carapace length, standard length, total length and individual weight. Tag numbers in those with readable tags were also recorded. After measurement the prawns were released to another well prepared 0.04 ha pond until the completion of data analysis for genetic evaluation purposes.

3. Survival and tag readability

Final survival rate of tagged juveniles ranged from 77.8 to 89.6 % with an average of 84%. The average retention of VIA tags was 60% and it ranged from 51.2 to 65%. Nearly 90% of the retained tags were readable. Those that were not readable due to tissue growth were removed and read, and a new tag was inserted before restocking the animal. The average harvest weight was 16.5±0.23 g. The proportion of females was 52.7%.

Cement tanks and pond rearing facilities at CIFA



4. Data analysis

The genetic evaluation of the third generation was conducted. The data set consisted of 2203 progeny that were the offspring of 45 dams and 32 sires. A mating list was designed to be used in the production of the fourth generation.

5. Production of Generation 4

Based on data analysis, breeding values of G3 individuals were estimated and families and individuals were ranked for undertaking the fourth round of selection and mate allocation. The mating cycle among selected individuals of G3 was initiated in the third week of June 2012. Post larvae from 58 full sib families of G4 were produced and nursed to taggable size. Out of the 58 full sib families 45 full sib families were selected (representing each of the 45 families of G3). The nursed juveniles from each of the 45 full sib families were divided into two groups; one group (140 individuals) was stocked in two large nylon net hapas (5 x 2 x 1m) for grow-out. These hapas were fixed in 100 m² concrete tanks or ponds. The other group (60 individuals) was individually tagged and stocked in two 0.04 ha earthen ponds for communal grow-out. All prawns were individually measured for total length, carapace length, standard length and wet weight before tagging. Grow-out is continuing at the time of writing this report.

6. On-Farm testing of Generation 3

Four farmers from the state of Orissa were selected for on-farm testing trials of G3. Samples of 400 to 500 post-larvae from each of the 45 full sib families were stocked in one 400 m² earthen pond to raise juveniles for on-farm testing. The prawns produced for on farm testing belonged to the CIFA selection (S) and control (C) lines. The post-larvae were fed daily with a commercial starter feed and reared for 70 days, after which the juveniles were collected and supplied to selected farmers. A total of 9200 juveniles (weighing approximately 2.8 g) were supplied to farmers in the last week of December 2011. The growth rate of prawns was monitored at monthly intervals. Final data were collected after 120 days of grow-out. Overall, the final average harvest body weight of the selection line was 44.5 ± 0.87 g, whereas that of the control line was 22.3 ± 0.86 g. One farmer reported good survival (70%), comparable to on station results and excellent growth (51.5 ± 1.24 g for the selection line and 22.5 ± 1.04 g for the control line). Another farmer got good growth (39.3 ± 1.0 g for selection line and 22.3 ± 1.58 g for control line) but survival was not very good (30%). Due to water scarcity during the grow-out period (January to April), two farmers were not able to maintain the recommended water levels and lost most of the stocked animals. These preliminary on farm testing results are very encouraging. Farmers and administrators often fear that the superiority recorded in selected lines in research stations may not be expressed when the animals are grown out in a farming environment. Our results suggest that this was not the case, and that the selected line outperformed the control line at the farm level. In more technical terms, there was no evidence of genotype by environment interaction.

Farmers that received prawns from the CIFA selected line expressed satisfaction with its performance. It is our intention to fine tune this assessment by conducting a rigorous comparison between the CIFA selected line and the stock that farmers would be normally using in its absence. In the event of a favorable outcome from such a comparison, we would initiate steps for the release of the improved strain to some carefully chosen hatcheries.

On farm testing site and performance recording



7. Meeting and group discussion

Dr. Raul Ponzoni, project leader from WorldFish visited CIFA during 23 to 25 April 2012. Dr. Ponzoni visited the field facilities of CIFA and discussed with project team. Dr. Bindu R. Pillai, principal investigator of the project from CIFA, made a Powerpoint presentation on the status of the project and progress made so far. Detailed discussions were held regarding the future course of action. Dr. Ponzoni also visited the on-farm trial site and interacted with the farmer with the help of project team. Prawn sampling was carried out in his presence.

On 13 October, Dr. Wagdy Mekkawy, project associate and scientist from WorldFish also visited CIFA and discussed technical matters with the project team.

Future Targets

- Grow out of G4 in hapas and ponds.
- Harvest, data collection and statistical analysis of grow out data.
- Genetic evaluation and preparation of mating for the next cycle of production.
- On farm testing of G4.
- Meeting and group discussion.
- Publication of research results.

Concluding remarks

The project has been going well and the overall balance following its implementation to date is highly positive. Not only has a substantial amount of knowledge essential for the effective conduct of a genetic improvement program for this species been accumulated, but also and equally importantly, the on-farm trials are beginning to show the potential benefits to producers from the use of the genetically improved strain.

However, a number of issues are of concern within the research team:

- The physical facilities in which the project is conducted are good, but they consist of an absolute minimum in terms of the number of families and individuals that can be handled in each generation. To ensure success and long term viability of the improved strain the facilities should be upgraded so that at least twice the number of families can be accommodated each generation. Otherwise, low effective population number and inevitable inbreeding will begin eroding the genetic gains made so far.
- Research attempting to unravel the mechanisms underlying the occurrence of male morphotypes should continue in order to increase the potential productivity of the species. This should include not only genetic studies but also rearing and finishing experiments on production systems to avoid competition and attain greater growth rates.
- The number of scientific publications resulting from this project has been limited. It has to be realized, however, that this is as one would anticipate. In projects such as the one in

question it takes several years before one has enough data to warrant a thorough analysis and subsequent publication of results. We now have sufficient data to justify a number of different analyses that will be reported in scientific papers. When analyses are conducted on limited data, rigor is inevitably compromised.

- There is room for improvement in administrative and financial aspects of the project. For example, it is now January 2013, and funds corresponding to the third year (2012) of project implementation have only just been received at CIFA. This will require granting an extension so that CIFA and WorldFish staff can adequately liquidate all expenses. In turn, this creates problems with WorldFish finance, which has been increasingly tightening the rules for accounting for expenses and accepts only small delays.

As a genetic improvement project, the present one is still in its infancy. It has undergone two cycles of three years each. It is now beginning to show its potential benefit to producers. However, to achieve full impact and to capitalize on the fruitful past efforts, further support well into the future will be required. Our intention is to apply for a further round of three years of funding, focusing on the issues raised above.

Publications

Pillai, B.R., Mahapatra, K. D., Ponzoni, R.W., Sahoo, L., Lalrinsanga, P.L., Nguyen, N.H., Mohanty, S., Sahu, S., Kumar, V., Sahu, S, Khaw, H.L., Patra,G., Patnaik, S., Rath, S. C. 2011. Genetic evaluation of a complete diallel cross involving three populations of freshwater prawn (*Macrobrachium rosenbergii*) from different geographical regions of India. *Aquaculture* 319: 347-354.

Pillai, B.R., Mahapatra, K. D., Ponzoni, R.W., Sahoo, L., Lalrinsanga, P.L., Nguyen, N.H., Mohanty, S., Sahu, S., Kumar, V., Sahu, S, Khaw, H.L., Patra,G., Patnaik, S., Eknath. A.E., 2011. Selective breeding of giant freshwater prawn *Macrobrachium rosenbergii* for improved harvest weight in India. Asian Pacific Aquaculture Conference, 17-20 January in Kochi, India.

Mahapatra, K. D., Pillai, B. R., Ponzoni, R.W., Sahoo, L., Lalrinsanga, P.L., Nguyen, N.H., Mohanty, S., Sahu, S., Kumar, V., Sahu, S, Khaw, H.L., Patra,G., Patnaik, S., Eknath. A.E., 2011. Estimation of heterosis effect on body traits in complete diallel cross involving three stocks of *Macrobrachium rosenbergii*. Asian Pacific Aquaculture Conference, 17-20 January in Kochi, India.

Mahapatra, K. D., Pillai, B. R., Ponzoni, R.W., Sahoo, L., Lalrinsanga, P.L., Nguyen, N.H., Mohanty, S., Sahu, S., Sahu, S, Khaw, H.L., Patra,G., Patnaik, S., Eknath. A.E., 2011. Heritability and genetic correlations of body traits at harvest in giant freshwater prawn *Macrobrachium rosenbergii*. 9th India Fisheries Forum. 19-23 Dec 2011, Chennai, India.

Pillai, B.R., Mahapatra, K.D., Ponzoni, R.W., Sahoo, L., Lalrinsanga, P.L., Mekki, W., Khaw, H.L., Nguyen, N.H., Mohanty, S., Sahu, S., Patra, G., 2013. Survival, sex ratio, male morphotype distribution, female reproductive status and tag losses in crosses among three populations of freshwater prawn *Macrobrachium rosenbergii* (de Man) in India (in preparation).

Farmer with his harvested prawns involved in on farm testing

